

TEXAS TRANSPORTATION Researcher

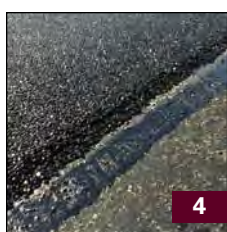
VOL. 48 | NO. 3 | 2012

Partners in Transportation Research





ON THE COVER: TTI researchers work with the Texas Department of Transportation to continuously improve the safety and sustainability of the Texas transportation system through the effective implementation of innovative research findings.



4



11



13



16

- 3 Partnering for Texas
- 4 Thin Is In: Thin Asphalt Overlay Helps Stretch Budgets Further
- 6 Testing Is Key to Roadside Safety
- 8 New Approaches to Traditional Research: Collecting and Analyzing Travel Data for TxDOT
- 10 The I-35 Expansion Project
- 12 Safety Experts Focus on Motorcycle Fatalities
- 13 Clear Approach: TTI Supports TxDOT's Aviation Division
- 14 Broader Shoulders Support Safer Roadways
- 15 Today's Forecast: More Rain — TTI Hydraulics, Sedimentation and Erosion Control Laboratory Expands
- 16 Providing Positive Protection for Work Zones
- 17 Institute News
- 20 TTI Publications

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TEXAS TRANSPORTATION Researcher

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Texas Transportation Researcher is published by the Texas A&M Transportation Institute to inform readers about its research, professional and service activities.

Opinions expressed in this publication by the editors/writers or the mention of brand names does not necessarily imply endorsement by the Texas A&M Transportation Institute or The Texas A&M University System Board of Regents.

Texas Transportation Researcher (ISSN 00404748) is a quarterly publication of TTI Communications, Texas A&M Transportation Institute, The Texas A&M University System, 3135 TAMU, College Station, Texas 77843-3135. Periodicals postage paid at College Station.

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Partnering for Texas

Better, Stronger, Together: TTI and the Texas Department of Transportation

Shortly after it was formed in 1917, the Texas Highway Department came to the Agricultural and Mechanical College of Texas looking for answers. Can we make this road last longer? Can we save taxpayer dollars and still do a better job? Can we save lives? The department was looking for a better way to build, maintain and improve the Texas transportation system.

The Texas A&M Transportation Institute (TTI) was born of that vision in 1950. Since then, our joint mission with the Texas Department of Transportation (TxDOT) hasn't changed much. As partners, we focus on creating innovative, implementable solutions to real-world problems to positively impact the state's 80,000-plus-mile network of roadways.

Some historical examples of the major advancements TTI and TxDOT have created together include:

- extensive high-occupancy vehicle lane systems in Houston and Dallas;
- roadside safety devices such as break-away signs, guard rails and crash cushions;
- the first traffic management systems in the country; and
- improved standards for highway sign visibility.

You'll see a number of examples of how we're still innovating together in this issue of the *Texas Transportation Researcher*.

TTI's data-collection experts across three different programs are helping TxDOT forecast the impact of air pollution on our urban centers' air quality. We've recommended new maintenance procedures for using very thin overlays to stretch taxpayer dollars without sacrificing pavement performance. We support TxDOT's

Aviation Division as it encourages economic development at the nearly 300 general aviation airports in the Lone Star State. And in the safety area, TTI has developed guidelines for improving work zone safety for motorists and workers alike, and we've aided TxDOT in capturing the life-saving value of widening the shoulders on rural roads.

TTI's state-of-the-practice test beds help answer the department's better-way questions. Read on to see how our crash-testing facility has enhanced driver safety via recommendations for improved roadside signs and pavement skid resistance. Meanwhile, over at the Hydraulics, Sedimentation and Erosion Control Laboratory, we're expanding our facility to provide more simulated rainfall testing for TxDOT and other sponsors.

One of the centerpiece projects we're currently teaming with TxDOT on is the expansion of I-35 from Hillsboro to Salado in the department's Waco District. Due for completion in 2017, this 96-mile, \$2.5 billion effort showcases the best of what TTI has to offer. Our researchers have developed a unique traveler-information system that pulls together distinct data sources to forecast travel times to commuters, freight haulers and emergency personnel during construction. Our mobility coordinators are serving as liaisons between TxDOT and citizen and business groups along

the corridor, getting the word out about the whys and wherefores of the expansion effort. In short, we're helping the medicine go down smoother while TxDOT focuses on what it does best: improving the Texas highway system.

By the way, you might have noticed in the second paragraph that TTI is now the Texas A&M Transportation Institute. All agencies of The Texas A&M University System, including TTI, have recently incorporated "A&M" into their names. With its focus on our Institute's historic partnership with TxDOT, it's somewhat fitting that this *Researcher* is the first issue to carry our new name.

When, in 1917, the Texas Highway Department came to the Agricultural and Mechanical College of Texas looking for answers, it found them in the minds of Aggie engineers. Today, TxDOT continues to ask questions, TTI continues to answer them, and Texans benefit from the conversation. You might even say our partnership has become a tradition here at the Texas A&M Transportation Institute. ■



by Dennis Christiansen
Agency Director



One inch of SMA thin asphalt overlay is placed in Bryan, Texas. The laydown machine uses TTI's Pave-IR system to detect uniformity of mat temperature.



The final mat of SMA thin asphalt overlay on SH 6 access road in Bryan, Texas.

With maintenance budgets stretched to their limits, perhaps thin asphalt overlays can fatten those thin budgets a bit. Texas A&M Transportation Institute (TTI) researchers have spent years refining thin asphalt overlay mixes that bridge the gap between high traffic loads and limited maintenance budgets.

Tom Scullion, manager of TTI's Flexible Pavements Program, and Cindy Estakhri, manager of TTI's Recyclable Materials Program, are working with the Texas Department of Transportation (TxDOT) to implement the use of three new thin asphalt mixes: a crack-attenuating mix (CAM), fine-graded stone matrix asphalt (SMA) and permeable friction course (PFC).

The goal of the research was to develop mixes that help to reduce costs by using a very thin overlay while

retaining quality. The research results indicate that the use of good-quality Grade 5 aggregate is one of the keys. "To place it thin, you need a smaller rock. Grade 5 aggregate is in abundant supply and is almost a waste product at some quarries. We felt we could obtain the Grade 5 aggregate at a reasonable cost," Estakhri notes.

Researchers wanted mixes that were easy for maintenance personnel to work with, very thin and easy to compact. To ensure the good quality of these

"Texas has such a huge network of roads to maintain, some in remote areas. TxDOT has to be more creative in terms of extending its dollars to cover more area."

Cindy Estakhri, manager of TTI's Recyclable Materials Program

mixes, all three of them have to pass the rutting (Hamburg wheel tracking test) and reflection cracking (overlay tester) performance tests.

The CAM mix was not originally intended to be a surface mix. The first purpose for this asphalt-rich mix was as a thin treatment below the surface to retard reflective cracking. In an early project in Houston, a CAM was placed on a high-volume interstate highway and left exposed to traffic for over one year. It performed very well, leading to its modification for use as a thin overlay for surface use. When used as a thin overlay, it's known as a fine dense-graded mix (DGM) instead of a CAM. By lowering the target density to 96.5 percent, the new DGM has between 0.7 percent and 1.0 percent less asphalt than the original CAM.

The fine-graded PFC was developed as an alternative to seal coat on lower-volume roadways. It drains well and has good friction characteristics. An added benefit is reduced noise compared to seal coats. Estakhri notes that "sometimes people complain about the noise associated with seal coats. Because PFC is finer, it makes for a quieter surface."

Sarah Horner, assistant area engineer with TxDOT's Brownwood District, oversaw the recent use of the fine-graded PFC on US 183 in Stephens County. The PFC was laid three quarters of an inch thick in both travel lanes. TxDOT hopes to combat a bleeding issue that compromised the existing surface. (Bleeding occurs when too much asphalt squeezes out on top of the aggregate, and this causes a slick surface.)

"We're hoping that the open PFC will allow the bleeding to go up into the PFC and keep it away from traffic. We're also hoping for a smoother, quieter ride," Horner says. They are expecting at least five years with little or no maintenance from the new PFC surface.

The fine-graded SMA has an excellent surface texture, resists rutting, and is useful on roadways with high volume and numerous intersections. Darlene Goehl, materials engineer for TxDOT's Bryan District, chose SMA for a recent resurfacing project on the access roads for SH 6. Goehl notes, "We can have problems with seal coats and turning movements. Seal coats often shove [or

ripple, creating a washboard effect] in an intersection. We were looking for a rut-resistant, crack-resistant thin mix that we could place in urban areas. We're expecting 10 to 12 years of service life from the SMA surface."

All three of the mixes were created as alternatives to seal coats or multiple inches of hot-mix asphalt. "It's not as cheap as a seal coat, but it will be cheaper than 2 inches of regular hot mix," says Estakhri. "Currently those are the alternatives. These mixes are in between those options. Even though they are much thinner, we think that these

overlay mixes will perform better than 2 inches of hot-mix asphalt."

Estakhri notes that TxDOT is incorporating these new mixes into its specifications. "Texas has such a huge network of roads to maintain, some in remote areas. TxDOT has to be more creative in terms of extending its dollars to cover more area," she says. ■



FOR MORE INFORMATION

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"We're hoping that the open PFC will allow the bleeding to go up into the PFC and keep it away from traffic. We're also hoping for a smoother, quieter ride."

Sarah Horner, TxDOT Brownwood District assistant area engineer

Three quarters of an inch of PFC thin asphalt overlay on US 183 south of Breckenridge, Texas, in Stephens County.



Sarah Horner, assistant area engineer with TxDOT's Brownwood District, performs a test on the new PFC surface on US 183 south of Breckenridge, Texas.

Testing Is Key to Roadside Safety

“Texas and every state in the country are constantly fighting friction loss: an invisible and extremely dangerous enemy. Over time, pavements can deteriorate and become slick from wear, and when they’re wet, it’s a recipe for disaster. Pavement is funny. You can’t just look at it and tell it’s dangerous. You have to test it.”

Dick Zimmer, TTI senior research specialist

Working together on a host of projects over the years, Texas A&M Transportation Institute (TTI) researchers at the Riverside Campus and Texas Department of Transportation (TxDOT) engineers have discovered innovative solutions involving the safety, installation and maintenance of the state’s seemingly endless number of highway signs. And, for the last four decades, the team has ensured that wet-weather travel on the state’s 80,000 miles of roadways is safe — thanks to a little-known but vital process of evaluating highly sophisticated and seldom-seen pieces of machinery built just for that purpose.

Skid Rigs and TTI’s Central/Western Field Test and Evaluation Center

TxDOT owns seven friction measurement systems, commonly called skid rigs. At a price tag of \$200,000 each, skid rigs consist of a heavy-duty pickup truck and trailer equipped with high-tech systems designed to measure the friction characteristics of pavement.

“Texas and every state in the country are constantly fighting friction loss: an invisible and extremely dangerous enemy,” TTI Senior Research Specialist Dick Zimmer explains. “Over time, pavements can deteriorate and become slick from wear, and when they’re wet, it’s a recipe for disaster. Pavement is funny. You can’t just look at it and tell it’s dangerous. You have to test it.”

To test the pavements, TxDOT uses its skid rigs to drive over half of its entire road system each year, says Magdy Mikhail, TxDOT’s director of the Pavement and Materials Systems Branch. “If the testing shows that a pavement is losing friction, then we determine what maintenance is required — like a new seal coat for example.”

But how does TxDOT know that its skid rigs are working properly?

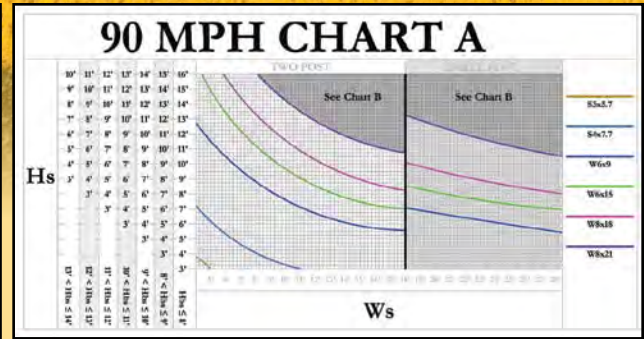
“In 1971, TTI opened the Field Test and Evaluation Center, located here at the Riverside Campus. In a nutshell, we test skid rigs, not only from Texas but from numerous other states as well,” explains Zimmer, who’s been evaluating these skid rigs at TTI for more than 40 years. He’s also served as the lead author on several related ASTM standards.

In 2011, the facility — now known as the Central/Western Field Test and Evaluation Center — was accredited by the American Association for Laboratory Accreditation for ISO 17025. “We’ve conducted nearly 500 of these evaluations and calibrations over the years,” Zimmer says.

That evaluation is a 3- to 5-day process that includes tests for compliance to ASTM standards and comparison of the state’s skid rig to TTI’s reference skid rig. They are both driven 108 times on three different types of pavements at three different speeds. The measurements of the two friction systems are initially compared. The numerous components are checked, recalibrated and tested again on the track. If maintenance or repair is needed, that work is performed as well.



TTI Technician Robert Kocman reviews computer data from the Area Reference Friction Measurement System (top). TTI’s skid rig in action at the Riverside Campus (bottom).



Wind damage causes fuse plate failures in signs like the ones shown here. TTI developed a wind-load chart to help reduce wind-induced failures of large guide signs.

“The public just drives down the road, never thinking of the people, the equipment and the technology that go into testing just one characteristic of our highway system,” Zimmer says. “It boils down to this: roads get slippery, and slippery roads can be dangerous. That’s why knowledge and prompt maintenance can save lives.”

“As an agency, we are very fortunate to have a facility like the one at TTI,” Mikhail says. “I feel like we are partners in the effort to provide the best and safest roadways possible for Texans. TTI’s evaluation center is a valuable resource for us.”

Highway Signs and the TTI/TxDOT Relationship

Over the last several years, TxDOT has discovered it was having problems related to its roadway signs — ranging from the large 18-foot-wide green guide signs to the much smaller mile-marker signs that cover the state’s transportation landscape.

For example, in West Texas, high-wind events were blowing down large guide signs at a higher than normal rate. In other districts, the use of small signs on slipbase supports was found to affect their crashworthiness.

“There were numerous issues we wanted to explore,” says TxDOT Transportation Engineer Doug Skowronek. “We organized a panel and developed a list of the various improvements we felt were needed. Many of those items were identified by the maintenance crews across the state responsible for maintaining and installing the signs.”

The list continued to grow, and TTI was awarded a two-year project, headed up by TTI Research Engineer Roger Bligh.

“Many of the design practices that TxDOT uses for sign mounting were established years ago, and because sign materials and installation methods change, problems sometimes arise,” Bligh says. “To complicate the issue further, the types of vehicles on the road change over time, as do the operating conditions of our highways.”

Skowronek says that the benefits from that two-year project were so great that TxDOT decided to extend the research for another year so additional issues could be examined. The project, Development Guidance for Sign Design Standards, was recently completed, resulting in an exhaustive 350-page report that identifies problems, findings, conclusions and recommendations.

“Obviously, we rely on TTI when it comes to these devices along our roadways. TTI helped us create the standards we use to install and maintain these signs and roadside devices. We come up with a ‘what if’ scenario, and TTI comes up with the answers.”

Doug Skowronek, TxDOT transportation engineer

“I was stunned at the detail and thoroughness of the report,” Skowronek says. “When you look through the report, you realize the work that went into it. It was very well thought out and documented, leaving nothing unanswered.”

TxDOT is now in the process of implementing recommendations from the report and expects a safer roadway, more efficient use of time and resources, and a substantial cost savings.

Among the findings and recommendations of the research project are:

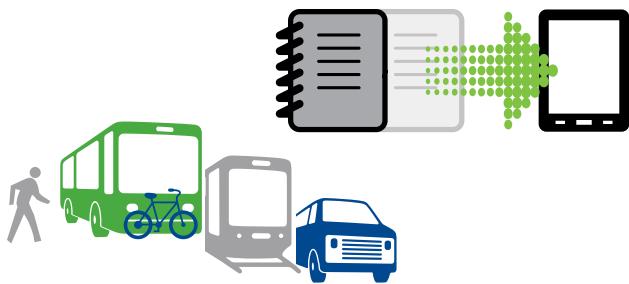
- Fuse plate failures were causing large guide signs to come down during high-wind events, so TTI developed new wind-load charts that properly account for the fuse plate strength.
- The use of expensive and cumbersome vertical supports for large guide signs, called stiffeners, are not needed to achieve proper impact performance of the sign support system.
- Researchers determined a minimum area for signs mounted on slipbase supports so that, upon impact, the slipbase works properly and minimizes damage to the impacting vehicle.

“Obviously, we rely on TTI when it comes to these devices along our roadways,” Skowronek says of the relationship between the two agencies. “TTI helped us create the standards we use to install and maintain these signs and roadside devices. We come up with a ‘what if’ scenario, and TTI comes up with the answers.” ■



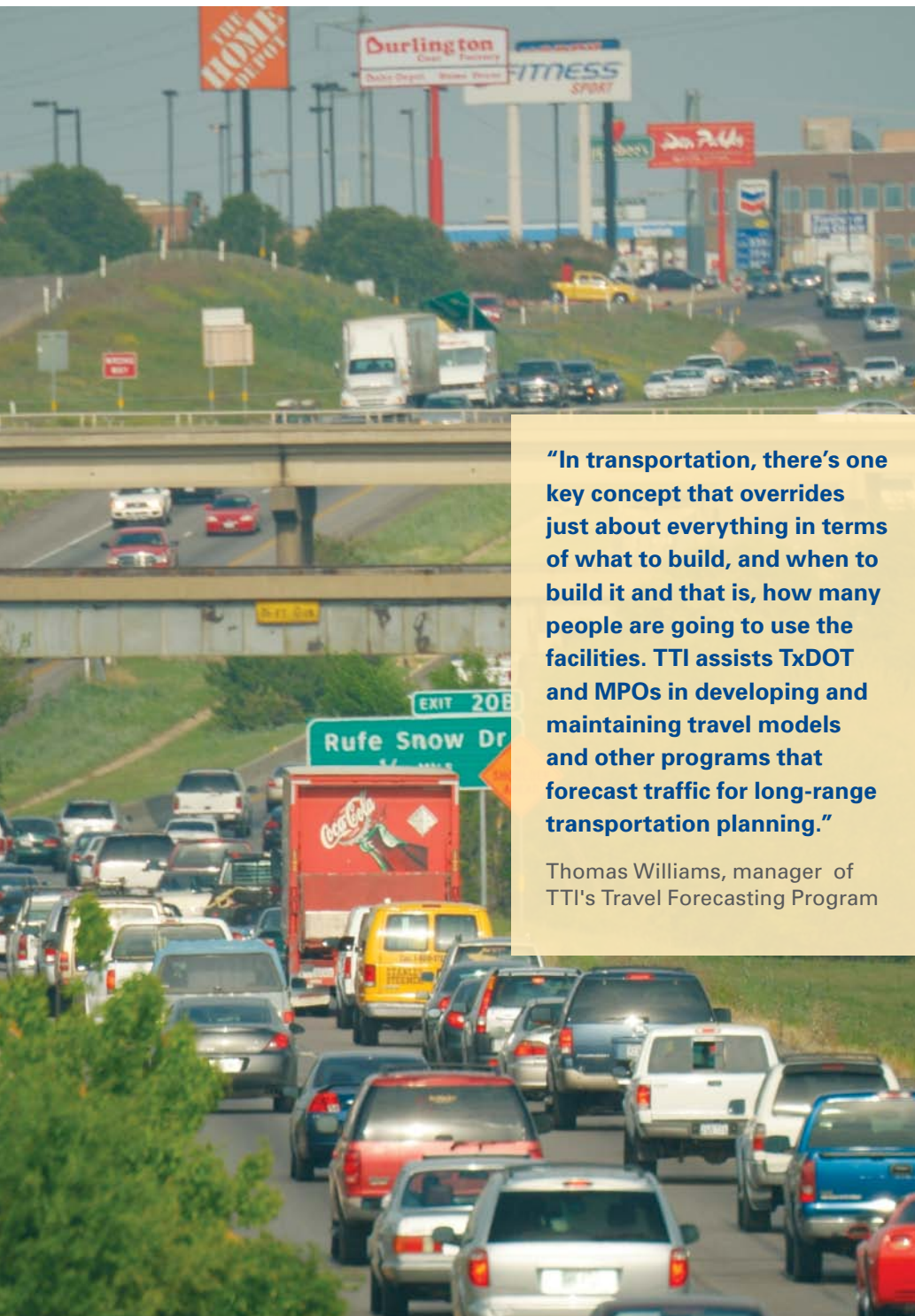
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New Approaches to Traditional Research

Collecting and Analyzing Travel Data for TxDOT



"In transportation, there's one key concept that overrides just about everything in terms of what to build, and when to build it and that is, how many people are going to use the facilities. TTI assists TxDOT and MPOs in developing and maintaining travel models and other programs that forecast traffic for long-range transportation planning."

Thomas Williams, manager of TTI's Travel Forecasting Program

Research programs at TTI work together to provide TxDOT with reliable information about travel planning, forecasting and modeling.

For over a half century, planning and analysis have been integral first steps in the transportation project selection process. Three programs at the Texas A&M Transportation Institute (TTI) work together to provide the Texas Department of Transportation (TxDOT) with relevant and accurate data so it can make fully informed decisions on transportation priorities in Texas.

Transportation Planning – Laying the Groundwork

For decades, states have relied on their citizens to answer questions about travel habits. Where are you traveling, what is the purpose of your travel, and how often do you travel? TTI's Transportation Planning Program conducts research on travel behavior and related travel-data-collection methods to help transportation planners answer these questions.

"In most mid-sized communities and certainly all major urban areas, travel-demand models are used to generate forecasts of future traffic levels as part of the transportation planning process," says TTI Transportation Planning Program Manager Ed Hard. "The models are important because there's never enough money to fund all projects, and results from the models can be used to help establish priorities based on where the need is the greatest or will be in the future."

The program's research and expertise helped lay the groundwork for TxDOT's Travel Survey Program, perhaps the most comprehensive survey and data-collection effort to support travel-demand modeling in the United States.

"TTI supports TxDOT's Travel Survey Program by analyzing information on the different components of travel that make up urban trip making," explains Hard. "We assist TxDOT with designs and methods for the various types of travel surveys needed to collect information

on each component of travel. These include travel related to area households, businesses and workplaces, commercial vehicles, and nonresidents of a given area.”

The Transportation Planning Program has recently started using new technology to collect origin-destination data, historically collected using a roadside travel survey.

“We have teamed with TTI’s Research and Implementation group in Houston to collect data on vehicular movements into, out of and through urban areas using Bluetooth® technology,” says Hard. Accurate data on these trip movements are one of the components of travel needed by TTI’s Travel Forecasting Program for model input. (For more information on this technology, visit the TTI website at <http://ttihouston.tamu.edu/bluetooth>.)

“Working with TTI on our Travel Survey Program provides a huge benefit to transportation planners,” says TxDOT Travel Survey Program Manager Charlie Hall. “The information can be used to make decisions about future road projects based on individual communities’ transportation needs.”

Travel Forecasting – Identifying Future Growth

Once travel survey data are compiled, they are used to formulate travel-demand models for forecasting future growth and demand for facilities.

“In transportation, there’s one key concept that overrides just about everything in terms of what to build and when to build it, and that is how many people are going to use the facilities,” says TTI Travel Forecasting Program Manager Thomas Williams. “TTI assists TxDOT and MPOs [municipal planning organizations] in developing and maintaining travel models and other programs that forecast traffic for long-range transportation planning.”

Transportation facilities — highways, roads, and bridges — represent significant investments and create the physical backbone of urban areas. That level of investment requires long-term planning, using forecasts 20 to 30 years into the future.

Travel forecasting has also evolved to include other modes of transportation such as transit, bicycles and pedestrians,

“Working with TTI on our Travel Survey Program provides a huge benefit to transportation planners. The information can be used to make decisions about future road projects based on individual communities’ transportation needs.”

Charlie Hall, TxDOT Travel Survey Program manager

and focuses more on personal travel behavior and choices. According to Williams, the shift has occurred as researchers are asked to review the efficiency of an existing transportation system, as opposed to the development of an entirely new network of roadways.

The Travel Forecasting Program is conducting several TxDOT research projects and providing technical assistance and technology-transfer support to TxDOT’s Planning and Programming (TPP) Division and MPOs in the state. The program uses survey data generated through TxDOT’s Travel Survey Program and provides input from the forecast models for air quality modeling done by TTI’s Transportation Modeling Program.

Among the beneficiaries of the research conducted by the Transportation Planning and Travel Forecasting Programs is the congestion index used in the annual *Urban Mobility Report* and the Texas Urban Mobility Plan, both led by TTI Senior Research Engineer Tim Lomax.

Transportation Modeling – Estimating Emissions

TTI’s Transportation Modeling Program also uses the information to estimate emissions in urban areas.

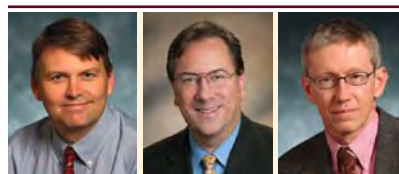
“The Transportation Planning Program collects the data, which are the empirical base of this pyramid. Then Travel Forecasting incorporates all the empirical travel data into its travel behavior models,” says Dennis Perkinson, program manager. “There are a lot of things you can do with this information, including traditional



TTI’s Transportation Planning Program collects information from citizens about their travel habits.

transportation planning. Demonstrating that air quality issues are not introduced is important. And for nonattainment areas, demonstrating air quality conformity is a requirement. That’s an air quality modeling exercise, which is based upon these layers of the pyramid.”

The Transportation Modeling Program develops accurate, reliable methods and procedures for estimating mobile source emissions. The program specializes in forecasting on-road mobile source emissions to demonstrate compliance with planning and air quality regulations, and provides support for TxDOT’s TPP Division through an interagency contract. The long-standing relationships with Texas’ major regulatory agencies — TxDOT and the Texas Commission on Environmental Quality — reflect the program’s commitment to excellence. ■



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The I-35 Expansion Project

Making the Most of Main Street Texas

"Reconstructing almost 100 miles of interstate is a massive job for the department, and at the end of the day we at TxDOT want to be as responsive and helpful as we can to our fellow Texans. Because of the scope of the project, that would be much more difficult without TTI's logistical support and technical know-how. Maybe even impossible."

Jodi Wheatley, TxDOT Waco District information specialist

Commuters and businesses alike will soon benefit from the expansion of I-35 in TxDOT's Waco District. Due for completion in 2017, the project is widening corridor capacity and improving safety to better meet the traveling needs of Texans.

Traffic congestion is as familiar as bluebonnets on the roadside for anyone who's traveled I-35 in the last 20 years.

The interstate route — which in Texas stretches south from the Red River all the way to the Rio Grande at Laredo — has carried commerce and commuters across the Lone Star State for nearly 150 years. Before the modern highway was christened I-35 in 1959, much of it was known as the Chisholm Trail.

Once crowded with cattle in long drives north to Kansas, today's I-35 has a similar reputation for being tightly packed — only now it's bumpers, not bovines, causing the slowdown. In an innovative approach to improving the roadway's capacity, the Texas Department of Transportation (TxDOT) created MY 35, a citizen-driven effort to expand a 96-mile stretch from Hillsboro to Salado of I-35 in the Waco District. At an estimated total cost of \$2.5 billion, the overall effort is made up of 17 smaller construction projects and targeted for completion in 2017.

TxDOT Teams with TTI

A project of this size is a huge undertaking, and not just when it comes to coordinating the construction itself. TxDOT is reconstructing nearly 100 miles of roadway in a relatively short amount of time, and that affects hundreds of thousands of citizens living nearby, tens of thousands of businesses, and millions of travelers over the life of the project.

TxDOT engaged the Texas A&M Transportation Institute (TTI) to provide independent technical support for the effort. One way TTI is helping is by providing mobility coordinators to keep citizen groups and businesses informed and lessen any negative impact of construction.

For example, TxDOT is converting many two-way access roads along the interstate to one way to improve safety. To business owners situated beside I-35, the change can seem threatening because, in the short term at least, it potentially changes customer access to their stores.



“Our job is to talk through the entire process with the business owner,” says TTI Research Engineer Jim Dale, lead mobility coordinator on the project. “We let them know we understand their concerns and help them see the longer-term benefits of the changes.”

Helping TxDOT get the word out is one of two major jobs for TTI on the project. The Institute developed a communications plan for the department and has done everything from designing flyers, truck stop signs and email alerts to organizing public meetings and writing, editing and distributing *My 35 Central Texas News*, a monthly newsletter aimed at keeping interested parties informed.

“Whatever means we use, our main goal is to get information into the hands of citizens and business owners so they can make the best decisions possible for their travel needs,” says Dale. “And very soon we’ll be getting the word out in a whole new way.”

Getting the Word Out in Real Time

What Dale is referring to is a first-of-its-kind traveler-information system developed by TTI for the I-35 project. The system integrates several methods for capturing data, forecasts congestion along the construction route, and provides that information to everyone who wants it. The system, currently being refined, is a primary example of how TxDOT and TTI are working together to improve transportation in Texas.

“The purpose of the system is two-fold,” explains TTI Research Scientist Bob Brydia, principal investigator on the traveler-information project. “First, it’ll give reliable traffic forecasts for I-35 travelers while the expansion project is under construction. Second, after construction is finished, it’ll form the basis for a comprehensive traffic management system for TxDOT’s Waco District.”

The traveler-information system is similar in concept to modern traffic management systems used in urban areas. The unique aspect is combining construction data and corridor travel data for a long interstate highway passing through rural and urban areas. Put simply, the system marries three data-gathering methods together to create

reliable forecasts for travelers:

1. Bluetooth® technology — Travelers’ devices (e.g., cell phones, laptops and the GPS systems in newer cars) are anonymously pinged at point A and point B, giving a reliable estimate of travel time between the points.
2. Wavetronix sensors — Placed strategically along the corridor at 17 points of high traffic interaction, such as where a state highway crosses I-35, these sensors capture traffic volume.
3. End-of-queue warning systems — Radar detectors mounted in orange barrels around work zones measure speeds of approaching vehicles as they near the work zone, and patterns of slowing traffic (indicating a backup in traffic flow) are noted.

TTI has developed computer algorithms to integrate this information together to create reliable traffic forecasts, which are then passed on to travelers. Once the system is fully up and running, travelers will be able to access reliable forecasts via the Internet of what traffic on I-35 in Waco will be in an hour, before they ever leave Hillsboro, some 40 miles away.

It sounds simple enough in theory, but gathering and analyzing the data and creating reliable forecasts are incredibly complex tasks. And different information systems have to talk effectively with one another to make sure the information stays accurate and useful by the time it reaches travelers.

“From our perspective, a real success story of this project is how effectively we’ve been able to interface with TxDOT’s LoneStar traffic management system,” says Brydia. “Using their data protocols, we feed our information to them, and that helps drive the messages you see on the portable changeable message signs [PCMSs].” PCMSs display traffic forecasts along the roadway.

While congestion can be inconvenient for travelers, it can also be costly — in very real terms — for big business. Knowing where work zones are, what lanes will be



<http://my35.org>

closed, and when to expect slower travel is vital for companies like Walmart and H-E-B. They rely on I-35 to get their goods via truck from major distribution hubs to their brick-and-mortar stores. When you’re talking perishables, traffic backups can mean the difference between fresh and spoiled milk — and that can translate into lost revenue for the company and higher prices for consumers.

Similarly, with better information on hand, emergency management services personnel can get to the scene of an accident sooner. The life-saving potential there really needs no further explanation.

“Right now, the main way for alerting travelers is via PCMSs and daily email alerts,” explains Brydia. “Very soon we hope to take advantage of social media, including Twitter, and supply real-time information to TxDOT’s My35.org website in the form of a dynamic traffic map.”

Jodi Wheatley, Waco District’s information specialist for the project, acknowledges that without TTI’s help, the I-35 expansion effort would have been much tougher.

“Reconstructing almost 100 miles of interstate is a massive job for the department, and at the end of the day we at TxDOT want to be as responsive and helpful as we can to our fellow Texans,” Wheatley says. “Because of the scope of the project, that would be much more difficult without TTI’s logistical support and technical know-how. Maybe even impossible.” ■



FOR MORE INFORMATION

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Safety Experts Focus on Motorcycle Fatalities

Sixteen percent of all vehicle fatalities in Texas involve motorcyclists, according to David Strickland, the administrator of the National Highway Traffic Safety Administration. A recently licensed motorcyclist himself, Strickland was a speaker during the opening session of the fourth annual Traffic Safety Conference in San Antonio this summer.

"I love motorcyclists, and I love motorcycling, but motorcyclists don't necessarily love me," Strickland told the crowd of more than 200 law-enforcement personnel, transportation researchers, policy makers, public health officials, traffic engineers and other safety professionals from around the state. "I will tell anybody: wear a helmet, wear the right clothing, and get yourself into a riding class. Because statistically



Described as Motorcycling 101, The Course for Motorcycle Riders teaches both new and experienced riders how to safely operate a motorcycle. Riders seeking a motorcycle license in Texas are required to take The Course.

speaking, you're on two wheels, so you're at a physical disadvantage. Why stack the odds against yourself even more?"

Strickland informed the group that motorcyclists also have a much higher rate of riding impaired when compared to passenger-vehicle drivers. And although Texas crash fatality rates have steadily decreased over the last several years, that's not the case where motorcycles are concerned. "The fatality rate with motorcycles is really keeping Texas back in term of overall fatalities," Strickland said.

"While we saw a decline in motorcycle deaths for the first time in over a decade in 2009, we must continue our efforts to promote sharing the road safely and watching out for motorcycles," says Research Scientist Patricia Turner of the Texas A&M Transportation Institute's Center for Transportation Safety. "The most recent statistics show that motor-

cycle fatalities increased by 10 percent, from 435 in 2010 to 479 in 2011."

An entire session of this year's Traffic Safety Conference was dedicated to motorcycle safety. Speakers for the session included Turner and Jude Schexnyder, chair of the Texas Motorcycle Safety Coalition.

"Motorcyclists are 25 more times more likely than passengers in cars to be killed in an accident, and they are five times more likely to be injured," TxDOT Deputy Executive Director John Barton said during his speech at the opening session of the conference.

Barton informed the crowd that he was involved in a crash with a motorcyclist in 1997. "I flat out did not see them," he said, adding that motorcycle safety programs like Share the Road are necessary. "It's important for all of us to remind each other that we have to pay attention and we have to take a second look." ■



FOR MORE INFORMATION

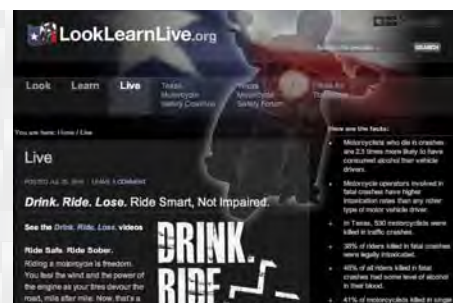
Contact Patty Turner at
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LookLearnLive.org

LookLearnLive.org promotes motorcycle safety through awareness and training for riders and motorists alike. Since its launch in 2009, the site has become a clearinghouse for all aspects of motorcycling including safety, legislation and riding events. Riders are also encouraged to visit the LookLearnLive.org Facebook page for timely announcements about riding safety.

"LookLearnLive.org is the go-to source for motorcycle safety in Texas," says site administrator Michelle Hoelscher, Texas A&M Transportation Institute (TTI) communications specialist. "We're reaching out to both motorcycle riders and motorists to say, 'Be more aware of each other. It's dangerous out there.'"

Besides informing visitors about safety statistics and best practices for maximizing safety (like looking left twice before entering an intersection), the site also promotes personal responsibility for riders through the "I Ride for Tomorrow" initiative. A form on the site asks bikers to accept personal responsibility for riding safely, legally and soberly. ■



Created by TTI in 2009, the Look, Learn, Live motorcycle safety campaign was launched by the Texas Department of Transportation to address the rising number of motorcycle fatalities in the state. Visit <http://looklearnlive.org> or Facebook at <http://www.facebook.com/TexasMotorcycleSafety>.

Clear Approach

TTI Supports TxDOT's Aviation Division

TTI supports TxDOT's Aviation Division with various airport issues such as technical analysis, planning and outreach.

Texans like to brag that everything is bigger and better in their native state. That's certainly true for the airport system in Texas, with nearly 300 general aviation airports, including 24 reliever airports, which stretch from Dalhart Municipal Airport in the corner of the Panhandle to Port Isabel-Cameron County in the Rio Grande Valley.

Overseeing this expanse of airports is the Texas Department of Transportation's (TxDOT's) Aviation Division, which is responsible for the planning and programming, engineering project management, and grant management for what is among the largest state airport systems in the country. For more than three decades, the Texas A&M Transportation Institute (TTI) has supported the mission of the Aviation Division through various efforts.

The cornerstone of TTI's statewide airport activities is participation in TxDOT's Regional Planning Meeting Program to develop and continuously improve the Texas Airport System Plan. TTI helps conduct public regional airport planning meetings across the state with airport managers, elected and appointed city and county officials, economic development officials, airport businesses, tenants, users, and other interested parties.

"The Regional Planning Meeting Program was implemented in large part by [retired TTI Senior Research Scientist] George Dresser," says TTI Research Scientist Jeff Borowiec. "This continuous airport planning process helps ensure that airports are meeting the needs of the communities they serve, and that the communities are using their airport as an economic generator."

Borowiec has also conducted research and technical analysis in support of the TxDOT Aviation Division leadership and staff in planning and programming functions of the Texas Airport System. (For examples of these projects, visit http://tti.tamu.edu/group/aviation/planning_research/.)

TTI staff also play major roles in the planning and execution of the annual Texas Aviation Conference. This conference attracts approximately 500 aviation officials from more than 20 states and provides professional development on the current issues, trends and challenges facing the aviation industry. TTI serves as technical

program chair and handles major logistical responsibilities to ensure high-level speakers, sessions and workshops, as well as suitable facilities and resources for the conference.

For the past five years, TTI has collaborated with TxDOT's Aviation and General Services Division, to produce *Wingtips*, a full-color, quarterly newsletter that serves as the official publication of TxDOT's Aviation Division. TTI Research Editor Chris Sasser serves as the managing editor of *Wingtips*.

"The goal of our publication is to tell the story of general aviation to our readers," says Sasser. "There are a lot of great success stories out there of TxDOT helping airports become impressive economic generators for their communities."

Through its diverse collaborative efforts with the Aviation Division, TTI hopes to continue their unique partnership for years to come.

"We have an excellent relationship with Jeff Borowiec and the staff at TTI," says Aviation Division Director David Fulton. "Their support is an integral part of our service to Texas airports." ■



FOR MORE INFORMATION

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Broader Shoulders Support Safer Roadways

The Numbers Are In

Texas highways are safer now thanks to scores of projects completed in the last few years to add shoulders and width on more than 1,000 miles of rural, two-lane highways, according to an analysis by the Texas A&M Transportation Institute (TTI).

The review of 189 Texas Department of Transportation (TxDOT) road projects around the state shows that wider pavements make highways safer and result in fewer crashes.

Recently, TxDOT asked TTI to analyze and review three years of pre- and post-improvement data on more than 1,000 miles of narrow two-lane highways that had been widened. The numbers show that on 1,159 miles of recently added highway shoulders, there were 133 fewer

fatalities and 895 fewer injuries compared to prior to widening.

TTI has estimated that these projects could save up to 44 lives each year or 880 lives over 20 years, and prevent 298 injuries or 5,960 injuries, respectively.

"Safety is our top priority," says TxDOT Executive Director Phil Wilson. "The agency's roadway-widening initiative has been a tremendous success, for increasing safety on Texas highways, saving lives and potentially saving billions of dollars associated with fatal crashes and sustained injuries."

In 2003, voters gave the Texas Transportation Commission the authority to issue \$3 billion in bonds to pay for state highway improvements. The law stipulated that 20 percent of that amount must be used to fund projects that would reduce crashes or correct or improve hazardous locations on the state system. The Texas Legislature later increased the bonding authority

to \$6 billion. In 2004, TTI helped TxDOT identify locations across the state where the road-widening projects could yield the most significant crash reductions.

TTI is also analyzing recently completed projects — mostly from the 2009 safety bond initiative — but these projects reflect only one or two years of post-construction crash data. Still, as a result of completed widening projects from that bond initiative, fatalities were reduced by an average of five annually. The \$29 million construction cost for those 37 projects — through the 20-year life of the project — could save an estimated \$456.4 million from fewer fatalities and serious injuries.

Researchers expect to update their analysis once three years of crash data are available for the balance of safety improvement projects across the state.

"I am proud of the role I played in creating the Safety Bond Program, and I sincerely thank TxDOT and the people of Texas for making it happen," says Sen. Steve Ogden.

TxDOT plans on expanding these efforts in the future in areas where widening improvements are needed. ■

"Safety is our top priority. The agency's roadway-widening initiative has been a tremendous success, for increasing safety on Texas highways, saving lives and potentially saving billions of dollars associated with fatal crashes and sustained injuries."

Phil Wilson, TxDOT executive director



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Today's Forecast: More Rain

TTI Hydraulics, Sedimentation and Erosion Control Laboratory Expands

The science of simulating rainfall is more complicated than you might think. Simulated raindrops need to be the right shape and velocity in order to produce the same effect as the real thing. And getting as close to the real thing as possible — in a controlled environment where results can be reproduced — is an important part of the Texas A&M Transportation Institute's (TTI's) Hydraulics, Sedimentation and Erosion Control Laboratory (HSECL) — a facility that will soon be expanding.

The indoor rainfall simulator subjects soil beds covered with erosion-control materials to three days of simulated rainfall to see how much soil the water carries away with it. Researchers replace the beds and replicate the test twice more to ensure the reliability of their results. And TTI's sponsors, like the Texas Department of Transportation (TxDOT), know the value of those results.

"TxDOT requires that erosion-control materials be on their Approved Products List in order for contractors to use the materials on TxDOT projects," says Jett McFalls, TTI assistant research scientist and manager of the HSECL. "To get on the list, products need to be tested by TTI and pass the required performance criteria. Contractors can then select an erosion-control product from the list depending on the slope and type of soil where it'll be used."

Currently, the lab has a waiting list, which can take more than a year for a manufacturer's product to be tested. Recent improvements to the facility include adding doors for better access, adding a bridge crane to lift collection bags out of the water-collection bays (instead of manually), and widening the bays for forklift access. These additions have improved setup and collection time, but there's still high demand for TTI testing.

"Right now, the lab tests two beds at a time, sand and clay, for each product," says McFalls. "We've seen so many requests that TTI is expanding the lab to a second building. We'll have three additional beds — two to test products and a third to use for things like sponsored research. The addition will

provide more flexibility for conducting research for a wide range of sponsors."

In addition, the expansion will allow the HSECL to be ASTM certified. "The new test beds will conform to ASTM International's criteria for testing," says Dennis Markwardt, director of vegetation management at TxDOT. "This will lend even more credibility to our data and ensure that we have good options for products that perform as stated, to stop erosion and provide good future performance. Numerous states use our data to make decisions as well."

The second indoor rainfall simulator building will be constructed next to the existing building, with a covered area between the two buildings to protect prepared soil beds from the elements.

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Dennis Markwardt, TxDOT director of vegetation management

Wet beds can affect data, so test beds start out dry. Additionally, TTI will build a soil storage building to protect the soil researchers use for their testing. The new facilities should be up and running by the spring of 2013. ■



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The HSECL currently tests erosion-control products on two soil beds at a time. An upcoming expansion will add three test beds in a second indoor rainfall simulator building.

Providing Positive Protection for Work Zones



When you get down to it, roadside safety is about minimizing negative impacts; in some cases, quite literally.

Safety in work zones is no different. The biggest threat to work-zone safety occurs when motorists and workers come into conflict — when a car strays into a work-zone area, for example, putting all involved at risk.

Of course, the safest solution is to always use positive protection to separate motorists and workers while work is ongoing. But that's not always possible in today's economic environment. Cash-strapped states have to optimize how resources are spent on their transportation networks.

Though the Texas Department of Transportation (TxDOT) has had procedures in place for assessing the need for positive protection for years, those guidelines relied on specific assumptions about where intrusions might occur. The agency decided it needed more comprehensive guidelines, so a team led by Jerry Ullman, manager of the Texas A&M Transportation Institute's Work Zone and Dynamic Message Sign Program, conducted a project to develop the needed guidelines.

"I feel that our real contribution in this project lies in generalizing the potential location of the worker or equipment throughout a given work-zone area," says Ullman. "This makes our model more realistic and, therefore, more accurate when applied to real-world situations."

Researchers looked at the number of vehicles traveling in a corridor to estimate the probability that a motorist-worker conflict would occur. Using those data, Ullman and his team compared the cost of installing and maintaining traffic barriers

with the societal costs associated with injuries and deaths resulting from crashes. From there, they came up with specific break-even recommendations for when Texas should introduce positive protection to work zones.

Put simply, the study showed that the closer the work area is to the travel lanes, the more justified positive protection is. That's because there's a higher probability, with a closer proximity of motorist to worker, for conflict to occur. As the distance between the travel lanes and the work-zone area increases, the cost benefit of installing protective barriers decreases at lower volumes.

Researchers also found that steel and mobile barriers can be cost-effective alternatives for short-duration mobile operations with workers on foot in high-volume, high-speed corridors. Truck-mounted attenuators were also found to be very cost effective, offsetting their costs in less than a year of use in most cases.

"Through this project, the researchers were able to determine when and under what conditions barrier protection is justified," says Research Engineer Wade Odell of TxDOT's Office of Research and Technology Implementation. "This is significant in that the contractor can provide motorists with proper protection in a work zone and still provide the protection cost effectively." ■

"Positive protection" refers to the addition of equipment (e.g., traffic barriers) to the work-zone environment to minimize or prevent motorist-worker conflict.



FOR MORE INFORMATION

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Safer Roads, More Work Highlighted at Traffic Safety Conference

As part of the theme of improving safety on highways in Texas and across the nation, the leader of the National Highway Traffic Safety Administration (NHTSA) and the retiring state legislator known as “Senator Safety” were featured speakers for TTI’s fourth annual Traffic Safety Conference June 4–6, in San Antonio.

David Strickland, NHTSA administrator, told the group of more than 200 that the nation now has its lowest number of traffic fatalities since 1949. “Those successes frankly pale to the fact of how many people



NHTSA Administrator David Strickland speaks at the Traffic Safety Conference.

we still lose. It is still vexing for all of us that when we do make gains, we still have that many more people we have to reach. The job is never, ever done,” he told the group of traffic safety professionals, pointing to the fact that 33,000 people die in crashes annually nationwide.

State Sen. Steve Ogden, who was the luncheon speaker later in the day, also acknowledged the decreasing fatality rate in Texas, but with a note of caution. “Over the last 10 years, our fatality rate has dropped by 25 percent.” Ogden noted that over 500 fewer Texans are dying on the roadways than just 10 years ago. “We have made a lot of progress. But, obviously we are not done.”

Ogden is credited with safety improvements on rural highways, supporting the installation of cable barriers in highway medians and creating the Center for Transportation Safety at TTI. “He consistently kept roadway safety in the minds of everyone in the legislature,” TTI Agency Director Dennis Christiansen said. ■

United Arab Emirates Project Addresses Crash Investigation and Reporting

TTI’s Center for Transportation Safety (CTS) is assisting the Emirate of Abu Dhabi with investigating crashes and analyzing post-crash site data.

“The United Arab Emirates, and especially the Emirate of Abu Dhabi, has an extremely high fatality rate,” says TTI Associate Research Scientist Troy Walden, project lead for CTS. “According to its Department of Transport [DOT], the Abu Dhabi fatality rate [based on population] is 50 percent higher than in the United States.”

Walden says DOT wants to start by developing a comprehensive set of procedures and guidelines that deal with the investigation and analysis of its fatal and injury crashes. Walden will produce separate guidebooks for both DOT and Abu Dhabi law-enforcement officers. The DOT guidebook will cover crash investigation and data analysis requirements and options for a reporting process. The guidebook for law-enforcement officers will focus on proper data collection and investigation procedures. ■

“Senator Safety” Honored at Annual TTI Safety Conference

State Sen. Steve Ogden was recently honored jointly by the three state agencies most involved in realizing his vision for enhancing roadway safety in Texas. The recognition came in response to Ogden’s keynote address at the annual Traffic Safety Conference in San Antonio on June 5.

“Mention the name ‘Senator Safety’ to just about anyone in or around the state capitol, and chances are, they’ll know exactly who you’re talking about,” noted TTI Director Dennis Christiansen in his recognition of Ogden. “In the history of the Texas Legislature, very few elected officials have been as steadfastly committed to roadway safety as Senator Steve Ogden. And, more important, even fewer have been as effective in their purpose.”

As part of the recognition, Ogden also earned praise from John Barton, deputy executive director and chief engineer of the Texas Department of Transportation (TxDOT) and Chief Luiz Gonzalez of the Texas Department of Public Safety.

Ogden served as chairman of the Senate Infrastructure Development and Security Committee when the legislature was shaping the state’s most significant transportation policy ever in 2003. As part of that legislation, the senator ensured that 20 percent of all roadway bond financing would be spent on safety improvements. More than \$1 billion has been invested in those safety improvements since the



(Left to right) TTI Agency Director Dennis Christiansen, State Sen. Steve Ogden, TxDOT Deputy Executive Director and Chief Engineer John Barton, and Texas Department of Public Safety Chief Luiz Gonzalez.

program began, and a TTI analysis demonstrates that the improvements have produced a benefit/cost ratio of 13 to 1. In human terms, that translates to more than 100 fewer crash fatalities and more than 1,000 fewer serious-injury crashes each year across Texas. ■

For more information about these news items or other media inquiries regarding TTI research, please contact Rick Davenport at (979) 862-3763 or r-davenport@tamu.edu.

Wunderlich Named Safety Center Acting Director



Wunderlich

Robert Wunderlich has been named the acting director for the Center for Transportation Safety at TTI. Wunderlich, who formerly served as the City of Gar-

land's senior managing director for transportation, streets, engineering and stormwater, also holds the title of research engineer since he assumed his new duties on July 9.

Wunderlich is responsible for leading the various research programs for the center, which was established by the Texas Legislature in 2001. He is also responsible for promoting the center's work to all of its internal and external stakeholder groups.

"We are extremely pleased that Robert is joining TTI," says Bill Stockton, TTI executive associate agency director. "His outstanding reputation and real-world experiences make him an ideal addition to our strong team."

"I feel that this new position is a unique opportunity to use my experience and skills to make a difference in the lives of Texans, Americans and others across the globe," Wunderlich says, "by helping to provide safer roadways and safer vehicle occupants, and by understanding and developing programs for high-risk groups."

Wunderlich is a past international president of the Institute of Transportation Engineers (ITE) and was named the Transportation Engineer of the Year by the Texas District of ITE in 2007. ■

Turnbull Receives the Ethel S. Birchland Lifetime Achievement Award

Internationally known transportation leader Katie Turnbull has been honored with a lifetime achievement award by the American Road and Transportation Builders Association's (ARTBA's) Transportation Development Foundation. Turnbull, TTI executive associate director, received the Ethel Birchland Lifetime Achievement Award July 26 in Lansdowne, Va.

Turnbull received the award through ARTBA's Women Leaders in Transportation Design and Construction Council (WLTDC). The WLTDC was established in 2010 to promote leadership and career advancement for women in the transportation design and construction industries.

Turnbull, who started at TTI in 1989 as an assistant research scientist, is a recognized expert on high-occupancy vehicle and high-occupancy toll facilities, public transportation, and travel demand management. She has nearly 35 years of experience in the transportation community. ■



TTI's Katie Turnbull (right) receives an ARTBA lifetime achievement award from WLTDC Chair Melissa Tooley.

TTI Helps Solve Central American Problems

TTI Senior Research Engineer Tom Scullion recently visited road builders in the Dominican Republic (DR) to help them construct their equivalent of the U.S. Interstate Highway System. The upgrade is more than a \$1 billion effort. One of the major links under construction is the AutoPista Del Coral, which links major tourist resorts in the east of the island.

The local engineers prefer to use cement-treated bases to handle their heavy truck loads and wet climate. Their main concern has been excessive shrinkage cracking, known as microcracking, which can severely impact pavement life. Several years ago DR engineers began following research conducted at TTI by Scullion and TTI Associate Research Scientist Stephen Sebesta to alleviate this problem.

Two days after finishing, a cured concrete-treated base is subjected to two to four passes with a heavy-slow moving vibratory roller. This causes the base to develop a network of fine cracks, which help prevent wider cracks over time by releasing pressure

like tiny fault lines in a tectonic plate. The fine cracks also minimize the risk of cracks in the base reflecting through the asphalt surface layer.

"The Brazilian contractor had never seen this technique before, and they were concerned that it may impact long-term strength gains," says Scullion. "My role was to explain the benefits of this technique."

Details on the microcracking procedure can be found in *Project Summary Report 0-4502-S: Microcracking for Reduced Shrinkage in Cement-Treated Base*. ■



Shrinkage cracking resulting from problems with cement-treated base.

TTI Contributes to Future of Road Vehicle Automation Workshop

TTI Senior Research Engineers Ginger Goodin and Ed Seymour attended a Transportation Research Board-sponsored workshop on the future of road vehicle automation July 24–26 in Irvine, Calif. They shared the state of the practice and participated in a discussion group to identify areas requiring further research. Goodin presented an overview of her research to a pre-conference workshop focused on managed lanes, including considerations for automated vehicles. The workshop was attended by a wide range of transportation professionals, including automobile manufacturers, universities, technology firms, insurance companies, federal agencies and European stakeholders.

“My goal was to set the stage for the research discussion by highlighting what was going on across the country [in this area],” says Goodin. “In the near term, managed lanes may provide next-generation cars with a designated lane where they can go at high speed with very close spacing and expand roadway capacity.” ■

Parrish Joins TTI Advisory Council



Colin Parrish, Gov. Rick Perry's advisor for budget, planning and policy, has recently joined TTI's Advisory Council. Parrish advises the governor on all transportation-related issues and serves on several advisory groups related to broad policy initiatives, finance and economic development.

Previously, Parrish was an aide to the Texas Transportation Commission, the five-member board that oversees the Texas Department of Transportation. He was chief of staff to State Rep. Wayne Smith, and managed the legislative and committee process for significant regulatory, environmental and transportation-related legislation.

“Colin's experience in transportation policy matters adds significant value to our advisory council,” says Dennis Christiansen, TTI agency director. “We are extremely pleased that he has taken the time to participate, and we will welcome his advice as we seek to continually enhance our transportation research program.”

The TTI Advisory Council advises TTI on transportation issues and trends and supports the Institute's research initiatives. ■

Geiselbrecht Receives IAP2 Certification



TTI Assistant Research Scientist Tina Geiselbrecht has successfully completed 40 hours of instruction by the International Association of Public Participation (IAP2), receiving the IAP2 Certification in Public Participation.

Geiselbrecht's work centers on public opinion research and public outreach. In assessing public opinion about planned transportation projects, she has conducted numerous stakeholder interviews, focus groups, surveys and discussion groups. The IAP2 certification enhances her skills in public engagement.

The five-day course included subjects involving effective public participation and public communication techniques.

IAP2 is recognized around the world, training employees in all fields concerned with public engagement. ■

Road User Fee Idea Slowly Gaining Momentum

Attendance for the most recent mileage-based user fee (MBUF) conference nearly doubled from last year, signaling growing interest in what many proponents admit could be decades before implementation.

MBUFs, also known as vehicle-miles-traveled fees, are one possibility to replace the current method of funding transportation needs. Instead of relying on an unsustainable gasoline tax to pay for road construction, motorists would be charged more directly for the amount they drive.

More than 250 people attended the Symposium on Mileage-Based User Fees and Transportation Finance in New Jersey this spring, sponsored by the International Bridge, Tunnel and Turnpike Association. TTI originated the symposium with the University of

Minnesota in 2009 and was a conference partner for this year's event.

“More and more people are talking about this topic as they realize that the gasoline tax is not adequate to meet our long-term needs,” says TTI Mobility Management Division Head Ginger Goodin, who was a panel discussion member at the symposium. Goodin and TTI Associate Transportation Researcher Trey Baker are among the national leaders in MBUF research.

The idea of a road-user fee was first discussed as a logical funding approach 10 years ago following an Oregon field test on the topic. Since then, five state departments of transportation and the I-95 Corridor Coalition in the Northeast have conducted studies. ■



TEXAS A&M TRANSPORTATION INSTITUTE

Publications

VIDEO SUMMARY REPORTS

Video Summary Reports are available on the Texas Department of Transportation's Research and Technology Implementation Office's YouTube channel at [YouTube /user/bestpracticevrs/](http://www.youtube.com/user/bestpracticevrs/).

Develop Practical Field Guidelines for the Compaction of HMA or WMA, **0-6992**.

Development of Very Thin Overlay Systems, **0-5598**.

Evaluation of Modern Traffic Control Devices to Improve Safety at Rural Intersections, **0-6462**.

FDR (Full-Depth-Reclamation) Performance Based Design, Construction, and Quality Control, **0-6271**.

Performance Evaluation and Mix Design for High RAP Mixtures, **0-6092**.

Shear Strengthening of Large Reinforced Concrete Elements Using Carbon Fiber Reinforced Polymer, **0-6306**.

TECHNICAL REPORTS

Accommodating Oversize and Overweight Loads: Technical Report, by Dan Middleton, **0-6404-1**, August 14, 2012.

Alternative Methods of Flexible Base Compaction Acceptance, by Stephen Sebesta, **0-6587-1**, June 4, 2012.

Best Practice for Using RAS in HMA, by Fujie Zhou, **0-6614-1**, April 30, 2012.

Comprehensive Evaluation of Compaction of Asphalt Pavements and Development of Compaction Monitoring, by Emad Kassem, **0-6992-2**, April 19, 2012.

Continuous Prestressed Concrete Girder Bridges, Volume 1: Literature Review and Preliminary Designs, by Mary Beth Hueste, **0-6651-1**, July 12, 2012.

Developing a Mixture Design Specification for Flexible Base Construction, by Wenting Liu, **0-6992-1**, August 13, 2012.

Development of TTI's Asphalt Compaction Monitoring System, by Jon Epps, **0-6621-1**, July 3, 2012.

Effects of Bending and Heat on the Ductility and Fracture Toughness of Flange Plate, by Peter Keating, **0-4624-2**, June 4, 2012.

Energy Developments and the Transportation Infrastructure in Texas: Impacts and Strategies, by Stephen Sebesta, **0-6271-2**, August 9, 2012.

Full-Depth Reclamation: New Test Procedures and Recommended Updates to Specifications, by Cesar Quiroga, **0-6498-1**, April 2, 2012.

Heatwux Patching at Two Locations in San Antonio, by Tom Freeman, **5-9043-01-1**, June 28, 2012.

Identification of Priority Rail Projects for Texas — Initial Methodology/User Manual and Guidebook, by Curtis Morgan, **0-6467-1**, May 15, 2012.

Implementation of Technology for Rapid Field Detection of Sulfate and Organic Content in Soils: Technical Report, by Chang-Seon Shon, **5-6362-01-1**, June 21, 2012.

Implementation of the Soil Compactor Analyzer into Test Method TEX-113-E: Technical Report, by Stephen Sebesta, **5-5135-01-1**, April 26, 2012.

Laboratory and Field Performance Measurements to Support the Implementation of Warm Mix Asphalt in Texas, by Cindy Estakhri, **5-5597-01-1**, August 10, 2012.

The Overlay Tester: A Sensitivity Study to Improve Repeatability and Minimize Variability in the Test Results, by Lubinda Walubita, **0-6607-1**, April 2, 2012.

Performance Comparison of Various Seal Coat Grades Used in Texas, by Paul Krugler, **0-6496-1**, August 9, 2012.

Performance Monitoring Pavements with Thermal Segregation in Texas, by Stephen Sebesta, **0-6080-1**, April 19, 2012.

Performance of Lap Splices in Large-Scale Column Specimens Affected by ASR and/or DEF, by Joe Bracci, **0-5722-1**, June 28, 2012.

Research and Recommendations for a Statewide Sign Retroreflectivity Maintenance Program, by Paul Carlson, **0-6408-1**, April 12, 2012.

Texas Flexible Pavements and Overlays: Year 1 Report — Test Sections, Data Collection, Analyses, and Data Storage System, by Lubinda Walubita, **0-6658-1**, July 13, 2012.

Texas M-E Flexible Pavement Design System: Literature Review and Proposed Framework, by Sheng Hu, **0-6622-1**, April 11, 2012.

Texas RPO Workshop Implementation Project Summary, by John Overman, **5-6483-01-1**, June 21, 2012.

Unknown Foundation Determination for Scour, by Jean-Louis Briaud, **0-6604-1**, May 3, 2012.

PROJECT SUMMARY REPORTS AND PRODUCTS

Asphalt Binder Brainstorm Workshop, by Fujie Zhou, **0-6674-P1**, August 9, 2012.

FDR (Full-Depth-Reclamation) Process Video, by Tom Scullion, **0-6271-P1**, June 4, 2012.

Full Depth Reclamation: Workshop Materials, by Tom Scullion, **0-6271-P2**, April 6, 2012.

Inspection Guide for Column Splice Regions Affected by Premature Concrete Deterioration: Draft, by Joe Bracci, **0-5722-P1**, June 28, 2012.

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